

SEQUENCE LISTING

(1) GENERAL INFORMATION:

- (i) APPLICANT: Gotschlich, Emil C.
- (ii) TITLE OF INVENTION: GLYCOSYLTRANSFERASES FOR BIOSYNTHESIS OF OLIGOSACCHARIDES, AND GENES ENCODING THEM
- (iii) NUMBER OF SEQUENCES: 12
- (iv) CORRESPONDENCE ADDRESS:
 - (A) ADDRESSEE: Klauber & Jackson
 - (B) STREET: 411 Hackensack Avenue
 - (C) CITY: Hackensack
 - (D) STATE: New Jersey
 - (E) COUNTRY: USA
 - (F) ZIP: 07601
- (v) COMPUTER READABLE FORM:
 - (A) MEDIUM TYPE: Floppy disk
 - (B) COMPUTER: IBM PC compatible
 - (C) OPERATING SYSTEM: PC-DOS/MS-DOS
 - (D) SOFTWARE: PatentIn Release #1.0, Version #1.25
- (vi) CURRENT APPLICATION DATA:
 - (A) APPLICATION NUMBER:
 - (B) FILING DATE:
 - (C) CLASSIFICATION:
- (vi) PRIOR APPLICATION DATA:
 - (A) APPLICATION NUMBER: 08/312,387
 - (B) FILING DATE: September 26, 1994
 - (C) CLASSIFICATION:
- (viii) ATTORNEY/AGENT INFORMATION:
 - (A) NAME: Jackson Esq., David A.
 - (B) REGISTRATION NUMBER: 26,742
 - (C) REFERENCE/DOCKET NUMBER: 600-1-095B
- (ix) TELECOMMUNICATION INFORMATION:
 - (A) TELEPHONE: 201 487-5800
 - (B) TELEFAX: 201 343-1684
 - (C) TELEX: 133521

(2) INFORMATION FOR SEQ ID NO:1:

- (i) SEQUENCE CHARACTERISTICS:
 - (A) LENGTH: 5859 base pairs
 - (B) TYPE: nucleic acid
 - (C) STRANDEDNESS: both
 - (D) TOPOLOGY: unknown
- (ii) MOLECULE TYPE: DNA (genomic)
- (iii) HYPOTHETICAL: NO
- (iv) ANTI-SENSE: NO
- (vi) ORIGINAL SOURCE:
 - (A) ORGANISM: Neisseria gonorrhoeae

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(B) STRAIN: F62

(ix) FEATURE:

(A) NAME/KEY: CDS
(B) LOCATION: 1..381
(C) GENE: glys (glycyl tRNA syntetase beta chain)

(ix) FEATURE:

(A) NAME/KEY: CDS
(B) LOCATION: 445..1491
(C) GENE: lgtA

(ix) FEATURE:

(A) NAME/KEY: CDS
(B) LOCATION: 2342..3262
(C) GENE: lgtC

(ix) FEATURE:

(A) NAME/KEY: CDS
(B) LOCATION: 3322..4335
(C) GENE: lgtD

(ix) FEATURE:

(A) NAME/KEY: CDS
(B) LOCATION: 4354..5196
(C) GENE: lgtE

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:1:

CTG	CAG	GCC	GTC	GCC	GTA	TTC	AAA	CAA	CTG	CCC	GAA	GCC	GCC	GCG	CTC	48
Leu	Gln	Ala	Val	Ala	Val	Phe	Lys	Gln	Leu	Pro	Glu	Ala	Ala	Ala	Leu	
1				5					10						15	
GCC	GCC	GCC	AAC	AAA	CGC	GTG	CAA	AAC	CTG	CTG	AAA	AAA	GCC	GAT	GCC	96
Ala	Ala	Ala	Asn	Lys	Arg	Val	Gln	Asn	Leu	Leu	Lys	Lys	Ala	Asp	Ala	
			20					25					30			
GCG	TTG	GGC	GAA	GTC	AAT	GAA	AGC	CTG	CTG	CAA	CAG	GAC	GAA	GAA	AAA	144
Ala	Leu	Gly	Glu	Val	Asn	Glu	Ser	Leu	Leu	Gln	Gln	Asp	Glu	Glu	Lys	
		35					40					45				
GCC	CTG	TAC	GCT	GCC	GCG	CAA	GGT	TTG	CAG	CCG	AAA	ATT	GCC	GCC	GCC	192
Ala	Leu	Tyr	Ala	Ala	Ala	Gln	Gly	Leu	Gln	Pro	Lys	Ile	Ala	Ala	Ala	
		50				55					60					
GTC	GCC	GAA	GGC	AAT	TTC	CGA	ACC	GCC	TTG	TCC	GAA	CTG	GCT	TCC	GTC	240
Val	Ala	Glu	Gly	Asn	Phe	Arg	Thr	Ala	Leu	Ser	Glu	Leu	Ala	Ser	Val	
	65				70					75					80	
AAG	CCG	CAG	GTT	GAT	GCC	TTC	TTC	GAC	GGC	GTG	ATG	GTG	ATG	GCG	GAA	288
Lys	Pro	Gln	Val	Asp	Ala	Phe	Phe	Asp	Gly	Val	Met	Val	Met	Ala	Glu	
			85						90					95		
GAT	GCC	GCC	GTA	AAA	CAA	AAC	CGC	CTG	AAC	CTG	CTG	AAC	CGC	TTG	GCA	336
Asp	Ala	Ala	Val	Lys	Gln	Asn	Arg	Leu	Asn	Leu	Leu	Asn	Arg	Leu	Ala	
			100					105					110			
GAG	CAG	ATG	AAC	GCG	GTG	GCC	GAC	ATC	GCG	CTT	TTG	GGC	GAG	TAACCGTTGT	388	
Glu	Gln	Met	Asn	Ala	Val	Ala	Asp	Ile	Ala	Leu	Leu	Gly	Glu			
		115					120					125				

ACAGTCCAAA TGCCGTCTGA AGCCTTCAGG CGGCATCAAA TTATCGGGAG AGTAAA	444
TTG CAG CCT TTA GTC AGC GTA TTG ATT TGC GCC TAC AAC GTA GAA AAA Met Gln Pro Leu Val Ser Val Leu Ile Cys Ala Tyr Asn Val Glu Lys 1 5 10 15	492
TAT TTT GCC CAA TCA TTA GCC GCC GTC GTG AAT CAG ACT TGG CGC AAC Tyr Phe Ala Gln Ser Leu Ala Ala Val Val Asn Gln Thr Trp Arg Asn 20 25 30	540
TTG GAT ATT TTG ATT GTC GAT GAC GGC TCG ACA GAC GGC ACA CTT GCC Leu Asp Ile Leu Ile Val Asp Asp Gly Ser Thr Asp Gly Thr Leu Ala 35 40 45	588
ATT GCC AAG GAT TTT CAA AAG CGG GAC AGC CGT ATC AAA ATC CTT GCA Ile Ala Lys Asp Phe Gln Lys Arg Asp Ser Arg Ile Lys Ile Leu Ala 50 55 60	636
CAA GCT CAA AAT TCC GGC CTG ATT CCC TCT TTA AAC ATC GGG CTG GAC Gln Ala Gln Asn Ser Gly Leu Ile Pro Ser Leu Asn Ile Gly Leu Asp 65 70 75 80	684
GAA TTG GCA AAG TCG GGG GGG GGG GGG GGG GAA TAT ATT GCG CGC ACC Glu Leu Ala Lys Ser Gly Gly Gly Gly Gly Glu Tyr Ile Ala Arg Thr 85 90 95	732
GAT GCC GAC GAT ATT GCC TCC CCC GGC TGG ATT GAG AAA ATC GTG GGC Asp Ala Asp Asp Ile Ala Ser Pro Gly Trp Ile Glu Lys Ile Val Gly 100 105 110	780
GAG ATG GAA AAA GAC CGC AGC ATC ATT GCG ATG GGC GCG TGG CTG GAA Glu Met Glu Lys Asp Arg Ser Ile Ile Ala Met Gly Ala Trp Leu Glu 115 120 125	828
GTT TTG TCG GAA GAA AAG GAC GGC AAC CGG CTG GCG CGG CAC CAC AAA Val Leu Ser Glu Glu Lys Asp Gly Asn Arg Leu Ala Arg His His Lys 130 135 140	876
CAC GGC AAA ATT TGG AAA AAG CCG ACC CGG CAC GAA GAC ATC GCC GCC His Gly Lys Ile Trp Lys Lys Pro Thr Arg His Glu Asp Ile Ala Ala 145 150 155 160	924
TTT TTC CCT TTC GGC AAC CCC ATA CAC AAC AAC ACG ATG ATT ATG CGG Phe Phe Pro Phe Gly Asn Pro Ile His Asn Asn Thr Met Ile Met Arg 165 170 175	972
CGC AGC GTC ATT GAC GGC GGT TTG CGT TAC GAC ACC GAG CGG GAT TGG Arg Ser Val Ile Asp Gly Gly Leu Arg Tyr Asp Thr Glu Arg Asp Trp 180 185 190	1020
GCG GAA GAT TAC CAA TTT TGG TAC GAT GTC AGC AAA TTG GGC AGG CTG Ala Glu Asp Tyr Gln Phe Trp Tyr Asp Val Ser Lys Leu Gly Arg Leu 195 200 205	1068
GCT TAT TAT CCC GAA GCC TTG GTC AAA TAC CGC CTT CAC GCC AAT CAG Ala Tyr Tyr Pro Glu Ala Leu Val Lys Tyr Arg Leu His Ala Asn Gln 210 215 220	1116
GTT TCA TCC AAA CAC AGC GTC CGC CAA CAC GAA ATC GCG CAA GGC ATC Val Ser Ser Lys His Ser Val Arg Gln His Glu Ile Ala Gln Gly Ile 225 230 235 240	1164

CAA AAA ACC GCC AGA AAC GAT TTT TTG CAG TCT ATG GGT TTT AAA ACC Gln Lys Thr Ala Arg Asn Asp Phe Leu Gln Ser Met Gly Phe Lys Thr 245 250 255	1212
CGG TTC GAC AGC CTA GAA TAC CGC CAA ACA AAA GCA GCG GCG TAT GAA Arg Phe Asp Ser Leu Glu Tyr Arg Gln Thr Lys Ala Ala Tyr Glu 260 265 270	1260
CTG CCG GAG AAG GAT TTG CCG GAA GAA GAT TTT GAA CGC GCC CGC CGG Leu Pro Lys Asp Leu Pro Glu Asp Phe Glu Arg Ala Arg Arg 275 280 285	1308
TTT TTG TAC CAA TGC TTC AAA CGG ACG GAC ACG CCG CCC TCC GGC GCG Phe Leu Tyr Gln Cys Phe Lys Arg Thr Asp Thr Pro Pro Ser Gly Ala 290 295 300	1356
TGG CTG GAT TTC GCG GCA GAC GGC AGG ATG AGG CGG CTG TTT ACC TTG Trp Leu Asp Phe Ala Ala Asp Gly Arg Met Arg Arg Leu Phe Thr Leu 305 310 315 320	1404
AGG CAA TAC TTC GGC ATT TTG TAC CGG CTG ATT AAA AAC CGC CGG CAG Arg Gln Tyr Phe Gly Ile Leu Tyr Arg Leu Ile Lys Asn Arg Arg Gln 325 330 335	1452
GCG CGG TCG GAT TCG GCA GGG AAA GAA CAG GAG ATT TAATGCAAAA Ala Arg Ser Asp Ser Ala Gly Lys Glu Gln Glu Ile 340 345	1498
CCACGTTATC AGCTTGGCTT CCGCCGCAGA ACGCAGGGCG CACATTGCCG CAACCTTCGG	1558
CAGTCGCGGC ATCCCGTTCC AGTTTTTCGA CGCACTGATG CCGTCTGAAA GGCTGGAACG	1618
GGCAATGGCG GAACTCGTCC CCGGCTTGTC GGCGCACCCC TATTTGAGCG GAGTGGAAAA	1678
AGCCTGCTTT ATGAGCCACG CCGTATTGTG GGAACAGGCA TTGGACGAAG GCGTACCGTA	1738
TATCGCCGTA TTTGAAGATG ATGTCTTACT CGGCGAAGGC GCGGAGCAGT TCCTTGCCGA	1798
AGATACTTGG CTGCAAGAAC GCTTTGACCC CGATTCCGCC TTTGTCGTCC GCTTGGAAC	1858
GATGTTTATG CACGTCCTGA CCTCGCCCTC CGGCGTGCGG GACTACGGCG GGCGCGCCTT	1918
TCCGCTTTTG GAAAGCGAAC ACTGCGGGAC GGCGGGCTAT ATTATTTCCC GAAAGGCGAT	1978
GCGTTTTTTC TTGGACAGGT TTGCCGTTTT GCCGCCGAA CGCCTGCACC CTGTCGATTT	2038
GATGATGTTT GGCAACCCTG ACGACAGGGA AGGAATGCCG GTTTGCCAGC TCAATCCCGC	2098
CTTGTCGCC CAAGAGCTGC ATTATGCCAA GTTTCACGAC CAAAACAGCG CATTGGGCAG	2158
CCTGATCGAA CATGACCGCC GCCTGAACCG CAAACAGCAA TGGCGCGATT CCCCCGCCAA	2218
CACATTCAAA CACCGCCTGA TCCGCGCCTT GACCAAAATC GGCAGGGAAA GGGAAAAACG	2278
CCGGCAAAGG CGCGAACAGT TAATCGGCAA GATTATTGTG CCTTTCCAAT AAAAGGAGAA	2338
AAG ATG GAC ATC GTA TTT GCG GCA GAC GAC AAC TAT GCC GCC TAC CTT Met Asp Ile Val Phe Ala Ala Asp Asp Asn Tyr Ala Ala Tyr Leu 1 5 10 15	2386
TGC GTT GCG GCA AAA AGC GTG GAA GCG GCC CAT CCC GAT ACG GAA ATC Cys Val Ala Ala Lys Ser Val Glu Ala Ala His Pro Asp Thr Glu Ile	2434

20										25					30					
AGG	TTC	CAC	GTC	CTC	GAT	GCC	GGC	ATC	AGT	GAG	GAA	AAC	CGG	GCG	GCG	2482				
Arg	Phe	His	Val	Leu	Asp	Ala	Gly	Ile	Ser	Glu	Glu	Asn	Arg	Ala	Ala					
			35					40					45							
GTT	GCC	GCC	AAT	TTG	CGG	GGG	GGG	GGT	AAT	ATC	CGC	TTT	ATA	GAC	GTA	2530				
Val	Ala	Ala	Asn	Leu	Arg	Gly	Gly	Gly	Asn	Ile	Arg	Phe	Ile	Asp	Val					
		50					55					60								
AAC	CCC	GAA	GAT	TTC	GCC	GGC	TTC	CCC	TTA	AAC	ATC	AGG	CAC	ATT	TCC	2578				
Asn	Pro	Glu	Asp	Phe	Ala	Gly	Phe	Pro	Leu	Asn	Ile	Arg	His	Ile	Ser					
	65					70					75									
ATT	ACG	ACT	TAT	GCC	CGC	CTG	AAA	TTG	GGC	GAA	TAC	ATT	GCC	GAT	TGC	2626				
Ile	Thr	Thr	Tyr	Ala	Arg	Leu	Lys	Leu	Gly	Glu	Tyr	Ile	Ala	Asp	Cys					
	80				85					90					95					
GAC	AAA	GTC	CTG	TAT	CTG	GAT	ACG	GAC	GTA	TTG	GTC	AGG	GAC	GGC	CTG	2674				
Asp	Lys	Val	Leu	Tyr	Leu	Asp	Thr	Asp	Val	Leu	Val	Arg	Asp	Gly	Leu					
			100						105					110						
AAG	CCC	TTA	TGG	GAT	ACC	GAT	TTG	GGC	GGT	AAC	TGG	GTC	GGC	GCG	TGC	2722				
Lys	Pro	Leu	Trp	Asp	Thr	Asp	Leu	Gly	Gly	Asn	Trp	Val	Gly	Ala	Cys					
			115					120					125							
ATC	GAT	TTG	TTT	GTC	GAA	AGG	CAG	GAA	GGA	TAC	AAA	CAA	AAA	ATC	GGT	2770				
Ile	Asp	Leu	Phe	Val	Glu	Arg	Gln	Glu	Gly	Tyr	Lys	Gln	Lys	Ile	Gly					
		130					135					140								
ATG	GCG	GAC	GGA	GAA	TAT	TAT	TTC	AAT	GCC	GGC	GTA	TTG	CTG	ATC	AAC	2818				
Met	Ala	Asp	Gly	Glu	Tyr	Tyr	Phe	Asn	Ala	Gly	Val	Leu	Leu	Ile	Asn					
		145				150					155									
CTG	AAA	AAG	TGG	CGG	CGG	CAC	GAT	ATT	TTC	AAA	ATG	TCC	TGC	GAA	TGG	2866				
Leu	Lys	Lys	Trp	Arg	Arg	His	Asp	Ile	Phe	Lys	Met	Ser	Cys	Glu	Trp					
					165					170					175					
GTG	GAA	CAA	TAC	AAG	GAC	GTG	ATG	CAA	TAT	CAG	GAT	CAG	GAC	ATT	TTG	2914				
Val	Glu	Gln	Tyr	Lys	Asp	Val	Met	Gln	Tyr	Gln	Asp	Gln	Asp	Ile	Leu					
				180					185					190						
AAC	GGG	CTG	TTT	AAA	GGC	GGG	GTG	TGT	TAT	GCG	AAC	AGC	CGT	TTC	AAC	2962				
Asn	Gly	Leu	Phe	Lys	Gly	Gly	Val	Cys	Tyr	Ala	Asn	Ser	Arg	Phe	Asn					
			195					200					205							
TTT	ATG	CCG	ACC	AAT	TAT	GCC	TTT	ATG	GCG	AAC	GGG	TTT	GCG	TCC	CGC	3010				
Phe	Met	Pro	Thr	Asn	Tyr	Ala	Phe	Met	Ala	Asn	Gly	Phe	Ala	Ser	Arg					
		210				215						220								
CAT	ACC	GAC	CCG	CTT	TAC	CTC	GAC	CGT	ACC	AAT	ACG	GCG	ATG	CCC	GTC	3058				
His	Thr	Asp	Pro	Leu	Tyr	Leu	Asp	Arg	Thr	Asn	Thr	Ala	Met	Pro	Val					
		225				230					235									
GCC	GTC	AGC	CAT	TAT	TGC	GGC	TCG	GCA	AAG	CCG	TGG	CAC	AGG	GAC	TGC	3106				
Ala	Val	Ser	His	Tyr	Cys	Gly	Ser	Ala	Lys	Pro	Trp	His	Arg	Asp	Cys					
	240				245					250					255					
ACC	GTT	TGG	GGT	GCG	GAA	CGT	TTC	ACA	GAG	TTG	GCC	GGC	AGC	CTG	ACG	3154				
Thr	Val	Trp	Gly	Ala	Glu	Arg	Phe	Thr	Glu	Leu	Ala	Gly	Ser	Leu	Thr					
				260					265					270						

ACC GTT CCC GAA GAA TGG CGC GGC AAA CTT GCC GTC CCG CCG ACA AAG	3202
Thr Val Pro Glu Glu Trp Arg Gly Lys Leu Ala Val Pro Pro Thr Lys	
275 280 285	
TGT ATG CTT CAA AGA TGG CGC AAA AAG CTG TCT GCC AGA TTC TTA CGC	3250
Cys Met Leu Gln Arg Trp Arg Lys Lys Leu Ser Ala Arg Phe Leu Arg	
290 295 300	
AAG ATT TAT TGACGGGGCA GGCCGTCTGA AGCCTTCAGA CGGCATCGGA	3299
Lys Ile Tyr	
305	
CGTATCGGAA AGGAGAAACG GA TTG CAG CCT TTA GTC AGC GTA TTG ATT TGC	3351
Met Gln Pro Leu Val Ser Val Leu Ile Cys	
1 5 10	
GCC TAC AAC GCA GAA AAA TAT TTT GCC CAA TCA TTG GCC GCC GTA GTG	3399
Ala Tyr Asn Ala Glu Lys Tyr Phe Ala Gln Ser Leu Ala Ala Val Val	
15 20 25	
GGG CAG ACT TGG CGC AAC TTG GAT ATT TTG ATT GTC GAT GAC GGC TCG	3447
Gly Gln Thr Trp Arg Asn Leu Asp Ile Leu Ile Val Asp Asp Gly Ser	
30 35 40	
ACG GAC GGC ACG CCC GCC ATT GCC CGG CAT TTC CAA GAA CAG GAC GGC	3495
Thr Asp Gly Thr Pro Ala Ile Ala Arg His Phe Gln Glu Gln Asp Gly	
45 50 55	
AGG ATC AGG ATA ATT TCC AAT CCC CGC AAT TTG GGC TTT ATC GCC TCT	3543
Arg Ile Arg Ile Ile Ser Asn Pro Arg Asn Leu Gly Phe Ile Ala Ser	
60 65 70	
TTA AAC ATC GGG CTG GAC GAA TTG GCA AAG TCG GGG GGG GGG GAA TAT	3591
Leu Asn Ile Gly Leu Asp Glu Leu Ala Lys Ser Gly Gly Gly Glu Tyr	
75 80 85 90	
ATT GCG CGC ACC GAT GCC GAC GAT ATT GCC TCC CCC GGC TGG ATT GAG	3639
Ile Ala Arg Thr Asp Ala Asp Asp Ile Ala Ser Pro Gly Trp Ile Glu	
95 100 105	
AAA ATC GTG GGC GAG ATG GAA AAA GAC CGC AGC ATC ATT GCG ATG GGC	3687
Lys Ile Val Gly Glu Met Glu Lys Asp Arg Ser Ile Ile Ala Met Gly	
110 115 120	
GCG TGG TTG GAA GTT TTG TCG GAA GAA AAC AAT AAA AGC GTG CTT GCC	3735
Ala Trp Leu Glu Val Leu Ser Glu Glu Asn Asn Lys Ser Val Leu Ala	
125 130 135	
GCC ATT GCC CGA AAC GGC GCA ATT TGG GAC AAA CCG ACC CGG CAT GAA	3783
Ala Ile Ala Arg Asn Gly Ala Ile Trp Asp Lys Pro Thr Arg His Glu	
140 145 150	
GAC ATT GTC GCC GTT TTC CCT TTC GGC AAC CCC ATA CAC AAC AAC ACG	3831
Asp Ile Val Ala Val Phe Pro Phe Gly Asn Pro Ile His Asn Asn Thr	
155 160 165 170	
ATG ATT ATG AGG CGC AGC GTC ATT GAC GGC GGT TTG CGG TTC GAT CCA	3879
Met Ile Met Arg Arg Ser Val Ile Asp Gly Gly Leu Arg Phe Asp Pro	
175 180 185	
GCC TAT ATC CAC GCC GAA GAC TAT AAG TTT TGG TAC GAA GCC GGC AAA	3927
Ala Tyr Ile His Ala Glu Asp Tyr Lys Phe Trp Tyr Glu Ala Gly Lys	

190										195					200					
CTG Leu	GGC Gly	AGG Arg 205	CTG Leu	GCT Ala	TAT Tyr	TAT Tyr	CCC Pro 210	GAA Glu	GCC Ala	TTG Leu	GTC Val	AAA Lys 215	TAC Tyr	CGC Arg	TTC Phe	3975				
CAT His	CAA Gln 220	GAC Asp	CAG Gln	ACT Thr	TCT Ser	TCC Ser 225	AAA Lys	TAC Tyr	AAC Asn	CTG Leu	CAA Gln 230	CAG Gln	CGC Arg	AGG Arg	ACG Thr	4023				
GCG Ala 235	TGG Trp	AAA Lys	ATC Ile	AAA Lys 240	GAA Glu	GAA Glu 240	ATC Ile	AGG Arg	GCG Ala	GGG Gly 245	TAT Tyr	TGG Trp	AAG Lys	GCG Ala 250	GCA Ala 250	4071				
GGC Gly	ATA Ile	GCC Ala	GTC Val	GGG Gly 255	GCG Ala	GAC Asp	TGC Cys	CTG Leu	AAT Asn 260	TAC Tyr	GGG Gly	CTT Leu	TTG Leu	AAA Lys 265	TCA Ser	4119				
ACG Thr	GCA Ala	TAT Tyr 270	GCG Ala	TTG Leu	TAC Tyr	GAA Glu	AAA Lys 275	GCC Ala	TTG Leu	TCC Ser	GGA Gly	CAG Gln	GAT Asp 280	ATC Ile	GGA Gly	4167				
TGC Cys	CTC Leu 285	CGC Arg	CTG Leu	TTC Phe	CTG Leu	TAC Tyr	GAA Glu 290	TAT Tyr	TTC Phe	TTG Leu	TCG Ser	TTG Leu 295	GAA Glu	AAG Lys	TAT Tyr	4215				
TCT Ser	TTG Leu 300	ACC Thr	GAT Asp	TTG Leu	CTG Leu	GAT Asp 305	TTC Phe	TTG Leu	ACA Thr	GAC Asp	CGC Arg 310	GTG Val	ATG Met	AGG Arg	AAG Lys	4263				
CTG Leu 315	TTT Phe	GCC Ala	GCA Ala	CCG Pro	CAA Gln 320	TAT Tyr	AGG Arg	AAA Lys	ATC Ile	CTG Leu 325	AAA Lys	AAA Lys	ATG Met	TTA Leu	CGC Arg 330	4311				
CCT Pro	TGG Trp	AAA Lys	TAC Tyr 335	CGC Arg	AGC Ser	TAT Tyr	TGAAAACCGAA	CAGGATAAAT	C	ATG Met 1	CAA Gln	AAC Asn				4362				
CAC His	GTT Val 5	ATC Ile	AGC Ser	TTG Leu	GCT Ala	TCC Ser 10	GCC Ala	GCA Ala	GAG Glu	CGC Arg	AGG Arg 15	GCG Ala	CAC His	ATT Ile	GCC Ala	4410				
GAT Asp 20	ACC Thr	TTC Phe	GGC Gly	AGT Ser	CGC Arg 25	GGC Gly	ATC Ile	CCG Pro	TTC Phe	CAG Gln 30	TTT Phe	TTC Phe	GAC Asp	GCA Ala	CTG Leu 35	4458				
ATG Met	CCG Pro	TCT Ser	GAA Glu	AGG Arg 40	CTG Leu	GAA Glu	CAG Gln	GCG Ala	ATG Met 45	GCG Ala	GAA Glu	CTC Leu	GTC Val	CCC Pro 50	GGC Gly	4506				
TTG Leu	TCG Ser	GCG Ala	CAC His 55	CCC Pro	TAT Tyr	TTG Leu	AGC Ser	GGA Gly 60	GTG Val	GAA Glu	AAA Lys	GCC Ala	TGC Cys 65	TTT Phe	ATG Met	4554				
AGC Ser	CAC His	GCC Ala	GTA Val 70	TTG Leu	TGG Trp	GAA Glu	CAG Gln 75	GCG Ala	TTG Leu	GAT Asp	GAA Glu	GGT Gly 80	CTG Leu	CCG Pro	TAT Tyr	4602				
ATC Ile	GCC Ala 85	GTA Val	TTT Phe	GAG Glu	GAC Asp	GAC Asp 90	GTT Val	TTA Leu	CTC Leu	GGC Gly	GAA Glu 95	GGC Gly	GCG Ala	GAG Glu	CAG Gln	4650				

TTC CTT GCC GAA GAT ACT TGG TTG GAA GAG CGT TTT GAC AAG GAT TCC Phe Leu Ala Glu Asp Thr Trp Leu Glu Glu Arg Phe Asp Lys Asp Ser 100 105 110 115	4698
GCC TTT ATC GTC CGT TTG GAA ACG ATG TTT GCG AAA GTT ATT GTC AGA Ala Phe Ile Val Arg Leu Glu Thr Met Phe Ala Lys Val Ile Val Arg 120 125 130	4746
CCG GAT AAA GTC CTG AAT TAT GAA AAC CGG TCA TTT CCT TTG CTG GAG Pro Asp Lys Val Leu Asn Tyr Glu Asn Arg Ser Phe Pro Leu Leu Glu 135 140 145	4794
AGC GAA CAT TGT GGG ACG GCT GGC TAT ATC ATT TCG CGT GAG GCG ATG Ser Glu His Cys Gly Thr Ala Gly Tyr Ile Ile Ser Arg Glu Ala Met 150 155 160	4842
CGG TTT TTC TTG GAC AGG TTT GCC GTT TTG CCG CCA GAG CGG ATT AAA Arg Phe Phe Leu Asp Arg Phe Ala Val Leu Pro Pro Glu Arg Ile Lys 165 170 175	4890
GCG GTA GAT TTG ATG ATG TTT ACT TAT TTC TTT GAT AAG GAG GGG ATG Ala Val Asp Leu Met Met Phe Thr Tyr Phe Phe Asp Lys Glu Gly Met 180 185 190 195	4938
CCT GTT TAT CAG GTT AGT CCC GCC TTA TGT ACC CAA GAA TTG CAT TAT Pro Val Tyr Gln Val Ser Pro Ala Leu Cys Thr Gln Glu Leu His Tyr 200 205 210	4986
GCC AAG TTT CTC AGT CAA AAC AGT ATG TTG GGT AGC GAT TTG GAA AAA Ala Lys Phe Leu Ser Gln Asn Ser Met Leu Gly Ser Asp Leu Glu Lys 215 220 225	5034
GAT AGG GAA CAA GGA AGA AGA CAC CGC CGT TCG TTG AAG GTG ATG TTT Asp Arg Glu Gln Gly Arg Arg His Arg Arg Ser Leu Lys Val Met Phe 230 235 240	5082
GAC TTG AAG CGT GCT TTG GGT AAA TTC GGT AGG GAA AAG AAG AAA AGA Asp Leu Lys Arg Ala Leu Gly Lys Phe Gly Arg Glu Lys Lys Lys Arg 245 250 255	5130
ATG GAG CGT CAA AGG CAG GCG GAG CTT GAG AAA GTT TAC GGC AGG CGG Met Glu Arg Gln Arg Gln Ala Glu Leu Glu Lys Val Tyr Gly Arg Arg 260 265 270 275	5178
GTC ATA TTG TTC AAA TAGTTTGTGT AAAATATAGG GGATTAAAAT CAGAAATGGA Val Ile Leu Phe Lys 280	5233
CACACTGTCA TTCCGCGCA GGCAGGAATC TAGGTCTTTA AACTTCGGTT TTTTCCGATA	5293
AATCTTGCC GCATTAAAT TCCAGATTCC CGCTTTCGCG GGGATGACGG CGGGGGGATT	5353
GTTGCTTTTT CGGATAAAT CCCGTGTTTT TTCATCTGCT AGGTAAAATC GCCCAAAGC	5413
GTCTGCATCG CGGCGATGGC GGCAGTGGG GCGGTTTCTG TGCATAAAAT CCGTTTTCCG	5473
AGTGTAACCG CCTGAAAGCC GGCTTCAAAT GCCTGTTGTT CTTCTGTTC TGTCCAGCCG	5533
CCTTCGGGCC CGACCATAAA GACGATTGCG CCGGACGGGT GGCAGATGTC GCCGAGTTTG	5593
CAGGCGCGGT TGATGCTCAT AATCAGCTTG GTGTTTTCAG ACGGCATTTT GTCGAGTGCT	5653

TCACGGTAGC CGATGATGGG CAGTACGGGG GGAACGGTGT TCCTGCCGCT TTGTTTCGCAC	5713
GCGGAGATGA CGATTTCTTG CCAGCGTGCG AGGCGTTTGG CGGCGCGTTC TCCGTCGAGG	5773
CGGACGATGC AGCGTTCGCT GATGACGGGC TGTATGGCGG TTACGCCGAG TTCGACGCTT	5833
TTTTGCAGGG TGAAATCCAT GCGATC	5859

(2) INFORMATION FOR SEQ ID NO:2:

- (i) SEQUENCE CHARACTERISTICS:
- (A) LENGTH: 126 amino acids
 - (B) TYPE: amino acid
 - (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:2:

Leu	Gln	Ala	Val	Ala	Val	Phe	Lys	Gln	Leu	Pro	Glu	Ala	Ala	Ala	Leu	1	5	10	15
Ala	Ala	Ala	Asn	Lys	Arg	Val	Gln	Asn	Leu	Leu	Lys	Lys	Ala	Asp	Ala	20	25	30	
Ala	Leu	Gly	Glu	Val	Asn	Glu	Ser	Leu	Leu	Gln	Gln	Asp	Glu	Glu	Lys	35	40	45	
Ala	Leu	Tyr	Ala	Ala	Ala	Gln	Gly	Leu	Gln	Pro	Lys	Ile	Ala	Ala	Ala	50	55	60	
Val	Ala	Glu	Gly	Asn	Phe	Arg	Thr	Ala	Leu	Ser	Glu	Leu	Ala	Ser	Val	65	70	75	80
Lys	Pro	Gln	Val	Asp	Ala	Phe	Phe	Asp	Gly	Val	Met	Val	Met	Ala	Glu	85	90	95	
Asp	Ala	Ala	Val	Lys	Gln	Asn	Arg	Leu	Asn	Leu	Leu	Asn	Arg	Leu	Ala	100	105	110	
Glu	Gln	Met	Asn	Ala	Val	Ala	Asp	Ile	Ala	Leu	Leu	Gly	Glu			115	120	125	

(2) INFORMATION FOR SEQ ID NO:3:

- (i) SEQUENCE CHARACTERISTICS:
- (A) LENGTH: 348 amino acids
 - (B) TYPE: amino acid
 - (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:3:

Met	Gln	Pro	Leu	Val	Ser	Val	Leu	Ile	Cys	Ala	Tyr	Asn	Val	Glu	Lys	1	5	10	15
Tyr	Phe	Ala	Gln	Ser	Leu	Ala	Ala	Val	Val	Asn	Gln	Thr	Trp	Arg	Asn	20	25	30	

Leu Asp Ile Leu Ile Val Asp Asp Gly Ser Thr Asp Gly Thr Leu Ala
 35 40 45
 Ile Ala Lys Asp Phe Gln Lys Arg Asp Ser Arg Ile Lys Ile Leu Ala
 50 55 60
 Gln Ala Gln Asn Ser Gly Leu Ile Pro Ser Leu Asn Ile Gly Leu Asp
 65 70 75 80
 Glu Leu Ala Lys Ser Gly Gly Gly Gly Gly Glu Tyr Ile Ala Arg Thr
 85 90 95
 Asp Ala Asp Asp Ile Ala Ser Pro Gly Trp Ile Glu Lys Ile Val Gly
 100 105 110
 Glu Met Glu Lys Asp Arg Ser Ile Ile Ala Met Gly Ala Trp Leu Glu
 115 120 125
 Val Leu Ser Glu Glu Lys Asp Gly Asn Arg Leu Ala Arg His His Lys
 130 135 140
 His Gly Lys Ile Trp Lys Lys Pro Thr Arg His Glu Asp Ile Ala Ala
 145 150 155 160
 Phe Phe Pro Phe Gly Asn Pro Ile His Asn Asn Thr Met Ile Met Arg
 165 170 175
 Arg Ser Val Ile Asp Gly Gly Leu Arg Tyr Asp Thr Glu Arg Asp Trp
 180 185 190
 Ala Glu Asp Tyr Gln Phe Trp Tyr Asp Val Ser Lys Leu Gly Arg Leu
 195 200 205
 Ala Tyr Tyr Pro Glu Ala Leu Val Lys Tyr Arg Leu His Ala Asn Gln
 210 215 220
 Val Ser Ser Lys His Ser Val Arg Gln His Glu Ile Ala Gln Gly Ile
 225 230 235 240
 Gln Lys Thr Ala Arg Asn Asp Phe Leu Gln Ser Met Gly Phe Lys Thr
 245 250 255
 Arg Phe Asp Ser Leu Glu Tyr Arg Gln Thr Lys Ala Ala Ala Tyr Glu
 260 265 270
 Leu Pro Glu Lys Asp Leu Pro Glu Glu Asp Phe Glu Arg Ala Arg Arg
 275 280 285
 Phe Leu Tyr Gln Cys Phe Lys Arg Thr Asp Thr Pro Pro Ser Gly Ala
 290 295 300
 Trp Leu Asp Phe Ala Ala Asp Gly Arg Met Arg Arg Leu Phe Thr Leu
 305 310 315 320
 Arg Gln Tyr Phe Gly Ile Leu Tyr Arg Leu Ile Lys Asn Arg Arg Gln
 325 330 335
 Ala Arg Ser Asp Ser Ala Gly Lys Glu Gln Glu Ile
 340 345

(2) INFORMATION FOR SEQ ID NO:4:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 306 amino acids
- (B) TYPE: amino acid
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:4:

```

Met Asp Ile Val Phe Ala Ala Asp Asp Asn Tyr Ala Ala Tyr Leu Cys
 1              5              10              15
Val Ala Ala Lys Ser Val Glu Ala Ala His Pro Asp Thr Glu Ile Arg
      20              25              30
Phe His Val Leu Asp Ala Gly Ile Ser Glu Glu Asn Arg Ala Ala Val
      35              40              45
Ala Ala Asn Leu Arg Gly Gly Gly Asn Ile Arg Phe Ile Asp Val Asn
      50              55              60
Pro Glu Asp Phe Ala Gly Phe Pro Leu Asn Ile Arg His Ile Ser Ile
      65              70              75              80
Thr Thr Tyr Ala Arg Leu Lys Leu Gly Glu Tyr Ile Ala Asp Cys Asp
      85              90              95
Lys Val Leu Tyr Leu Asp Thr Asp Val Leu Val Arg Asp Gly Leu Lys
      100             105             110
Pro Leu Trp Asp Thr Asp Leu Gly Gly Asn Trp Val Gly Ala Cys Ile
      115             120             125
Asp Leu Phe Val Glu Arg Gln Glu Gly Tyr Lys Gln Lys Ile Gly Met
      130             135             140
Ala Asp Gly Glu Tyr Tyr Phe Asn Ala Gly Val Leu Leu Ile Asn Leu
      145             150             155             160
Lys Lys Trp Arg Arg His Asp Ile Phe Lys Met Ser Cys Glu Trp Val
      165             170             175
Glu Gln Tyr Lys Asp Val Met Gln Tyr Gln Asp Gln Asp Ile Leu Asn
      180             185             190
Gly Leu Phe Lys Gly Gly Val Cys Tyr Ala Asn Ser Arg Phe Asn Phe
      195             200             205
Met Pro Thr Asn Tyr Ala Phe Met Ala Asn Gly Phe Ala Ser Arg His
      210             215             220
Thr Asp Pro Leu Tyr Leu Asp Arg Thr Asn Thr Ala Met Pro Val Ala
      225             230             235             240
Val Ser His Tyr Cys Gly Ser Ala Lys Pro Trp His Arg Asp Cys Thr
      245             250             255
Val Trp Gly Ala Glu Arg Phe Thr Glu Leu Ala Gly Ser Leu Thr Thr
      260             265             270

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Val Pro Glu Glu Trp Arg Gly Lys Leu Ala Val Pro Pro Thr Lys Cys
 275 280 285
 Met Leu Gln Arg Trp Arg Lys Lys Leu Ser Ala Arg Phe Leu Arg Lys
 290 295 300
 Ile Tyr
 305

(2) INFORMATION FOR SEQ ID NO:5:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 337 amino acids
- (B) TYPE: amino acid
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:5:

Met Gln Pro Leu Val Ser Val Leu Ile Cys Ala Tyr Asn Ala Glu Lys
 1 5 10 15
 Tyr Phe Ala Gln Ser Leu Ala Ala Val Val Gly Gln Thr Trp Arg Asn
 20 25 30
 Leu Asp Ile Leu Ile Val Asp Asp Gly Ser Thr Asp Gly Thr Pro Ala
 35 40 45
 Ile Ala Arg His Phe Gln Glu Gln Asp Gly Arg Ile Arg Ile Ile Ser
 50 55 60
 Asn Pro Arg Asn Leu Gly Phe Ile Ala Ser Leu Asn Ile Gly Leu Asp
 65 70 75 80
 Glu Leu Ala Lys Ser Gly Gly Gly Glu Tyr Ile Ala Arg Thr Asp Ala
 85 90 95
 Asp Asp Ile Ala Ser Pro Gly Trp Ile Glu Lys Ile Val Gly Glu Met
 100 105 110
 Glu Lys Asp Arg Ser Ile Ile Ala Met Gly Ala Trp Leu Glu Val Leu
 115 120 125
 Ser Glu Glu Asn Asn Lys Ser Val Leu Ala Ala Ile Ala Arg Asn Gly
 130 135 140
 Ala Ile Trp Asp Lys Pro Thr Arg His Glu Asp Ile Val Ala Val Phe
 145 150 155 160
 Pro Phe Gly Asn Pro Ile His Asn Asn Thr Met Ile Met Arg Arg Ser
 165 170 175
 Val Ile Asp Gly Gly Leu Arg Phe Asp Pro Ala Tyr Ile His Ala Glu
 180 185 190
 Asp Tyr Lys Phe Trp Tyr Glu Ala Gly Lys Leu Gly Arg Leu Ala Tyr
 195 200 205
 Tyr Pro Glu Ala Leu Val Lys Tyr Arg Phe His Gln Asp Gln Thr Ser

210	215	220
Ser Lys Tyr Asn Leu Gln Gln Arg Arg Thr Ala Trp Lys Ile Lys Glu		
225	230	235 240
Glu Ile Arg Ala Gly Tyr Trp Lys Ala Ala Gly Ile Ala Val Gly Ala		
	245	250 255
Asp Cys Leu Asn Tyr Gly Leu Leu Lys Ser Thr Ala Tyr Ala Leu Tyr		
	260	265 270
Glu Lys Ala Leu Ser Gly Gln Asp Ile Gly Cys Leu Arg Leu Phe Leu		
	275	280 285
Tyr Glu Tyr Phe Leu Ser Leu Glu Lys Tyr Ser Leu Thr Asp Leu Leu		
	290	295 300
Asp Phe Leu Thr Asp Arg Val Met Arg Lys Leu Phe Ala Ala Pro Gln		
305	310	315 320
Tyr Arg Lys Ile Leu Lys Lys Met Leu Arg Pro Trp Lys Tyr Arg Ser		
	325	330 335
Tyr		

(2) INFORMATION FOR SEQ ID NO:6:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 280 amino acids
- (B) TYPE: amino acid
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:6:

Met	Gln	Asn	His	Val	Ile	Ser	Leu	Ala	Ser	Ala	Ala	Glu	Arg	Arg	Ala
1				5				10						15	
His	Ile	Ala	Asp	Thr	Phe	Gly	Ser	Arg	Gly	Ile	Pro	Phe	Gln	Phe	Phe
			20					25					30		
Asp	Ala	Leu	Met	Pro	Ser	Glu	Arg	Leu	Glu	Gln	Ala	Met	Ala	Glu	Leu
		35					40					45			
Val	Pro	Gly	Leu	Ser	Ala	His	Pro	Tyr	Leu	Ser	Gly	Val	Glu	Lys	Ala
	50					55			60						
Cys	Phe	Met	Ser	His	Ala	Val	Leu	Trp	Glu	Gln	Ala	Leu	Asp	Glu	Gly
65				70					75					80	
Leu	Pro	Tyr	Ile	Ala	Val	Phe	Glu	Asp	Asp	Val	Leu	Leu	Gly	Glu	Gly
			85					90					95		
Ala	Glu	Gln	Phe	Leu	Ala	Glu	Asp	Thr	Trp	Leu	Glu	Glu	Arg	Phe	Asp
		100					105					110			
Lys	Asp	Ser	Ala	Phe	Ile	Val	Arg	Leu	Glu	Thr	Met	Phe	Ala	Lys	Val
	115						120					125			

Ile Val Arg Pro Asp Lys Val Leu Asn Tyr Glu Asn Arg Ser Phe Pro
 130 135 140

Leu Leu Glu Ser Glu His Cys Gly Thr Ala Gly Tyr Ile Ile Ser Arg
 145 150 155 160

Glu Ala Met Arg Phe Phe Leu Asp Arg Phe Ala Val Leu Pro Pro Glu
 165 170 175

Arg Ile Lys Ala Val Asp Leu Met Met Phe Thr Tyr Phe Phe Asp Lys
 180 185 190

Glu Gly Met Pro Val Tyr Gln Val Ser Pro Ala Leu Cys Thr Gln Glu
 195 200 205

Leu His Tyr Ala Lys Phe Leu Ser Gln Asn Ser Met Leu Gly Ser Asp
 210 215 220

Leu Glu Lys Asp Arg Glu Gln Gly Arg Arg His Arg Arg Ser Leu Lys
 225 230 235 240

Val Met Phe Asp Leu Lys Arg Ala Leu Gly Lys Phe Gly Arg Glu Lys
 245 250 255

Lys Lys Arg Met Glu Arg Gln Arg Gln Ala Glu Leu Glu Lys Val Tyr
 260 265 270

Gly Arg Arg Val Ile Leu Phe Lys
 275 280

(2) INFORMATION FOR SEQ ID NO:7:

- (i) SEQUENCE CHARACTERISTICS:
 - (A) LENGTH: 5859 base pairs
 - (B) TYPE: nucleic acid
 - (C) STRANDEDNESS: both
 - (D) TOPOLOGY: unknown
- (ii) MOLECULE TYPE: DNA (genomic)
- (iii) HYPOTHETICAL: NO
- (iv) ANTI-SENSE: NO
- (vi) ORIGINAL SOURCE:
 - (A) ORGANISM: Neisseria gonorrhoeae
 - (B) STRAIN: F62
- (ix) FEATURE:
 - (A) NAME/KEY: CDS
 - (B) LOCATION: 1491..2330
 - (C) GENE: lgtB

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:7:

CTGCAGGCCG TCGCCGTATT CAAACAACCTG CCCGAAGCCG CCGCGCTCGC CGCCGCCAAC	60
AAACGCGTGC AAAACCTGCT GAAAAAAGCC GATGCCGCGT TGGGCGAAGT CAATGAAAGC	120
CTGCTGCAAC AGGACGAAGA AAAAGCCCTG TACGCTGCCG CGCAAGGTTT GCAGCCGAAA	180

ATTGCCGCCG CCGTCGCCGA AGGCAATTTC CGAACCGCCT TGTCCGAACT GGCTTCCGTC	240
AAGCCGCAGG TTGATGCCTT CTTGCACGGC GTGATGGTGA TGGCGGAAGA TGCCGCCGTA	300
AAACAAAACC GCCTGAACCT GCTGAACCGC TTGGCAGAGC AGATGAACGC GGTGGCCGAC	360
ATCGCGCTTT TGGGCGAGTA ACCGTTGTAC AGTCCAAATG CCGTCTGAAG CCTTCAGGCG	420
GCATCAAATT ATCGGGAGAG TAAATTGCAG CCTTTAGTCA GCGTATTGAT TTGCGCCTAC	480
AACGTAGAAA AATATTTTGC CCAATCATTG GCCGCCGTCG TGAATCAGAC TTGGCGCAAC	540
TTGGATATTT TGATTGTCGA TGACGGCTCG ACAGACGGCA CACTTGCCAT TGCCAAGGAT	600
TTTCAAAAGC GGGACAGCCG TATCAAAATC CTTGCACAAG CTCAAAATTC CGGCCTGATT	660
CCCTCTTTAA ACATCGGGCT GGACGAATTG GCAAAGTCGG GGGGGGGGGG GGGGGAATAT	720
ATTGCGCGCA CCGATGCCGA CGATATTGCC TCCCCCGCT GGATTGAGAA AATCGTGGGC	780
GAGATGGAAA AAGACCGCAG CATCATTGCG ATGGGCGCGT GGCTGGAAGT TTTGTCGGAA	840
GAAAAGGACG GCAACCGGCT GGCGCGGCAC CACAAACAGC GCAAATTTG GAAAAAGCCG	900
ACCCGGCAGC AAGACATCGC CGCCTTTTTC CCTTTCGGCA ACCCCATACA CAACAACAGC	960
ATGATTATGC GGCGCAGCGT CATTGACGGC GGTTTGCCTT ACGACACCGA GCGGGATTGG	1020
GCGGAAGATT ACCAATTTTG GTACGATGTC AGCAAATTGG GCAGGCTGGC TTATTATCCC	1080
GAAGCCTTGG TCAAATACCG CCTTCACGCC AATCAGGTTT CATCCAAACA CAGCGTCCGC	1140
CAACACGAAA TCGCGCAAGG CATCCAAAAA ACCGCCAGAA ACGATTTTTT GCAGTCTATG	1200
GGTTTTAAAA CCCGGTTCGA CAGCCTAGAA TACCGCCAAA CAAAAGCAGC GCGGTATGAA	1260
CTGCCGGAGA AGGATTTGCC GGAAGAAGAT TTTGAACGCG CCCGCCGGTT TTTGTACCAA	1320
TGCTTCAAAC GGACGGACAC GCCGCCCTCC GGCGCGTGGC TGGATTTCGC GGCAGACGGC	1380
AGGATGAGGC GGCTGTTTAC CTTGAGGCAA TACTTCGGCA TTTTGTACCG GCTGATTAAA	1440
AACCGCCGGC AGGCGCGGTC GGATTCGGCA GGGAAAGAAC AGGAGATTTA ATG CAA	1496
	Met Gln
	1
AAC CAC GTT ATC AGC TTG GCT TCC GCC GCA GAA CGC AGG GCG CAC ATT	1544
Asn His Val Ile Ser Leu Ala Ser Ala Ala Glu Arg Arg Ala His Ile	
5 10 15	
GCC GCA ACC TTC GGC AGT CGC GGC ATC CCG TTC CAG TTT TTC GAC GCA	1592
Ala Ala Thr Phe Gly Ser Arg Gly Ile Pro Phe Gln Phe Phe Asp Ala	
20 25 30	
CTG ATG CCG TCT GAA AGG CTG GAA CGG GCA ATG GCG GAA CTC GTC CCC	1640
Leu Met Pro Ser Glu Arg Leu Glu Arg Ala Met Ala Glu Leu Val Pro	
35 40 45 50	
GGC TTG TCG GCG CAC CCC TAT TTG AGC GGA GTG GAA AAA GCC TGC TTT	1688
Gly Leu Ser Ala His Pro Tyr Leu Ser Gly Val Glu Lys Ala Cys Phe	
55 60 65	

ATG AGC CAC GCC GTA TTG TGG GAA CAG GCA TTG GAC GAA GGC GTA CCG Met Ser His Ala Val Leu Trp Glu Gln Ala Leu Asp Glu Gly Val Pro 70 75 80	1736
TAT ATC GCC GTA TTT GAA GAT GAT GTC TTA CTC GGC GAA GGC GCG GAG Tyr Ile Ala Val Phe Glu Asp Asp Val Leu Leu Gly Glu Gly Ala Glu 85 90 95	1784
CAG TTC CTT GCC GAA GAT ACT TGG CTG CAA GAA CGC TTT GAC CCC GAT Gln Phe Leu Ala Glu Asp Thr Trp Leu Gln Glu Arg Phe Asp Pro Asp 100 105 110	1832
TCC GCC TTT GTC GTC CGC TTG GAA ACG ATG TTT ATG CAC GTC CTG ACC Ser Ala Phe Val Val Arg Leu Glu Thr Met Phe Met His Val Leu Thr 115 120 125 130	1880
TCG CCC TCC GGC GTG GCG GAC TAC GGC GGG CGC GCC TTT CCG CTT TTG Ser Pro Ser Gly Val Ala Asp Tyr Gly Gly Arg Ala Phe Pro Leu Leu 135 140 145	1928
GAA AGC GAA CAC TGC GGG ACG GCG GGC TAT ATT ATT TCC CGA AAG GCG Glu Ser Glu His Cys Gly Thr Ala Gly Tyr Ile Ile Ser Arg Lys Ala 150 155 160	1976
ATG CGT TTT TTC TTG GAC AGG TTT GCC GTT TTG CCG CCC GAA CGC CTG Met Arg Phe Phe Leu Asp Arg Phe Ala Val Leu Pro Pro Glu Arg Leu 165 170 175	2024
CAC CCT GTC GAT TTG ATG ATG TTC GGC AAC CCT GAC GAC AGG GAA GGA His Pro Val Asp Leu Met Met Phe Gly Asn Pro Asp Asp Arg Glu Gly 180 185 190	2072
ATG CCG GTT TGC CAG CTC AAT CCC GCC TTG TGC GCC CAA GAG CTG CAT Met Pro Val Cys Gln Leu Asn Pro Ala Leu Cys Ala Gln Glu Leu His 195 200 205 210	2120
TAT GCC AAG TTT CAC GAC CAA AAC AGC GCA TTG GGC AGC CTG ATC GAA Tyr Ala Lys Phe His Asp Gln Asn Ser Ala Leu Gly Ser Leu Ile Glu 215 220 225	2168
CAT GAC CGC CGC CTG AAC CGC AAA CAG CAA TGG CGC GAT TCC CCC GCC His Asp Arg Arg Leu Asn Arg Lys Gln Gln Trp Arg Asp Ser Pro Ala 230 235 240	2216
AAC ACA TTC AAA CAC CGC CTG ATC CGC GCC TTG ACC AAA ATC GGC AGG Asn Thr Phe Lys His Arg Leu Ile Arg Ala Leu Thr Lys Ile Gly Arg 245 250 255	2264
GAA AGG GAA AAA CGC CGG CAA AGG CGC GAA CAG TTA ATC GGC AAG ATT Glu Arg Glu Lys Arg Arg Gln Arg Arg Glu Gln Ile Gly Lys Ile 260 265 270	2312
ATT GTG CCT TTC CAA TAAAAGGAGA AAAGATGGAC ATCGTATTTG CGGCAGACGA Ile Val Pro Phe Gln 275 280	2367
CAACTATGCC GCCTACCTTT GCGTTGCGGC AAAAAGCGTG GAAGCGGCCC ATCCCATAAC	2427
GGAAATCAGG TTCCACGTCC TCGATGCCGG CATCAGTGAG GAAAACCGGG CGGCGGTTGC	2487
CGCCAATTTG CGGGGGGGGG GTAATATCCG CTTTATAGAC GTAAACCCCG AAGATTTCGC	2547

CGGCTTCCCC	TTAAACATCA	GGCACATTTT	CATTACGACT	TATGCCC GCC	TGAAATTGGG	2607
CGAATACATT	GCCGATTGCG	ACAAAGTCCT	GTATCTGGAT	ACGGACGTAT	TGGTCAGGGA	2667
CGGCCTGAAG	CCCTTATGGG	ATACCGATTT	GGGCGGTAAC	TGGGTCGGCG	CGTGCATCGA	2727
TTTGTTTGTC	GAAAGGCAGG	AAGGATACAA	ACAAAAAATC	GGTATGGCGG	ACGGAGAATA	2787
TTATTTC AAT	GCCGGCGTAT	TGCTGATCAA	CCTGAAAAAG	TGGCGGCGGC	ACGATATTTT	2847
CAAAATGTCC	TGCGAATGGG	TGGAACAATA	CAAGGACGTG	ATGCAATATC	AGGATCAGGA	2907
CATTTTGAAC	GGGCTGTTTA	AAGGCGGGGT	GTGTTATGCG	AACAGCCGTT	TCAACTTTAT	2967
GCCGACCAAT	TATGCCTTTA	TGGCGAACGG	GTTTGCGTCC	CGCCATACCG	ACCCGCTTTA	3027
CCTCGACCGT	ACCAATACGG	CGATGCCCCG	CGCCGTCAGC	CATTATTGCG	GCTCGGCAAA	3087
GCCGTGGCAC	AGGGACTGCA	CCGTTTGGGG	TGCGGAACGT	TTCACAGAGT	TGGCCGGCAG	3147
CCTGACGACC	GTTCCCGAAG	AATGGCGCGG	CAAAGTTGCC	GTCCCGCCGA	CAAAGTGTAT	3207
GCTTCAAAGA	TGGCGCAAAA	AGCTGTCTGC	CAGATTCTTA	CGCAAGATTT	ATTGACGGGG	3267
CAGGCCGTCT	GAAGCCTTCA	GACGGCATCG	GACGTATCGG	AAAGGAGAAA	CGGATTGCAG	3327
CCTTTAGTCA	GCGTATTGAT	TTGCGCCTAC	AACGCAGAAA	AATATTTTGC	CCAATCATTG	3387
GCCGCCGTAG	TGGGGCAGAC	TTGGCGCAAC	TTGGATATTT	TGATTGTGCG	TGACGGCTCG	3447
ACGGACGGCA	CGCCCGCCAT	TGCCCGGCAT	TTCCAAGAAC	AGGACGGCAG	GATCAGGATA	3507
ATTTCCAATC	CCCGCAATTT	GGGCTTTATC	GCCTCTTTAA	ACATCGGGCT	GGACGAATTG	3567
GCAAAGTCGG	GGGGGGGGGA	ATATATTGCG	CGCACCGATG	CCGACGATAT	TGCCTCCCCC	3627
GGCTGGATTG	AGAAAATCGT	GGGCGAGATG	GAAAAAGACC	GCAGCATCAT	TGCGATGGGC	3687
GCGTGGTTGG	AAGTTTTGTC	GGAAGAAAAC	AATAAAAGCG	TGCTTGCCGC	CATTGCCCGA	3747
AACGGCGCAA	TTTGGGACAA	ACCGACCCGG	CATGAAGACA	TTGTCGCCGT	TTTCCCTTTC	3807
GGCAACCCCA	TACACAACAA	CACGATGATT	ATGAGGCGCA	GCGTCATTGA	CGGCGGTTTG	3867
CGGTTGATC	CAGCCTATAT	CCACGCCGAA	GACTATAAGT	TTTGGTACGA	AGCCGGCAAA	3927
CTGGGCAGGC	TGGCTTATTA	TCCCGAAGCC	TTGGTCAAAT	ACCGCTTCCA	TCAAGACCAG	3987
ACTTCTTCCA	AATACAACCT	GCAACAGCGC	AGGACGGCGT	GGAAAAATCA	AGAAGAAATC	4047
AGGGCGGGGT	ATTGGAAGGC	GGCAGGCATA	GCCGTCGGGG	CGGACTGCCT	GAATTACGGG	4107
CTTTTGAAAT	CAACGGCATA	TGCGTTGTAC	GAAAAAGCCT	TGTCCGGACA	GGATATCGGA	4167
TGCCTCCGCC	TGTTCTGTGA	CGAATATTTT	TTGTCGTTGG	AAAAGTATTC	TTTGACCGAT	4227
TTGCTGGATT	TCTTGACAGA	CCGCGTGATG	AGGAAGCTGT	TTGCCGCACC	GCAATATAGG	4287
AAAATCCTGA	AAAAAATGTT	ACGCCCTTGG	AAATACCGCA	GCTATTGAAA	CCGAACAGGA	4347
TAAATCATGC	AAAACCACGT	TATCAGCTTG	GCTTCCGCCG	CAGAGCGCAG	GGCGCACATT	4407

GCCGATACCT TCGGCAGTCG CGGCATCCCG TTCCAGTTTT TCGACGCACT GATGCCGTCT	4467
GAAAGGCTGG AACAGGCGAT GCGGGAAGTC GTCCCCGGCT TGTCGGCGCA CCCCTATTTG	4527
AGCGGAGTGG AAAAAGCCTG CTTTATGAGC CACGCCGTAT TGTGGGAACA GGC GTTGGAT	4587
GAAGGTCTGC CGTATATCGC CGTATTTGAG GACGACGTTT TACTCGGCGA AGGCGCGGAG	4647
CAGTTCCTTG CCGAAGATAC TTGGTTGGAA GAGCGTTTTG ACAAGGATTC CGCCTTTATC	4707
GTCCGTTTGG AAACGATGTT TCGGAAAGTT ATTGTCAGAC CGGATAAAGT CCTGAATTAT	4767
GAAAACCGGT CATTTCTTTT GCTGGAGAGC GAACATTGTG GGACGGCTGG CTATATCATT	4827
TCGCGTGAGG CGATGCGGTT TTTCTTGAC AGGTTTGCCG TTTTGCCGCC AGAGCGGATT	4887
AAAGCGGTAG ATTTGATGAT GTTTACTTAT TTCTTTGATA AGGAGGGGAT GCCTGTTTAT	4947
CAGGTTAGTC CCGCCTTATG TACCCAAGAA TTGCATTATG CCAAGTTTCT CAGTCAAAAC	5007
AGTATGTTGG GTAGCGATTT GGAAAAAGAT AGGGAACAAG GAAGAAGACA CCGCCGTTTCG	5067
TTGAAGGTGA TGTTTGACTT GAAGCGTGCT TTGGGTAAAT TCGGTAGGGA AAAGAAGAAA	5127
AGAATGGAGC GTCAAAGGCA GCGGAGCTT GAGAAAGTTT ACGGCAGGCG GGTCATATTG	5187
TTCAAATAGT TTGTGTAAAA TATAGGGGAT TAAAATCAGA AATGGACACA CTGTCAATCC	5247
CGCGCAGGCG GGAATCTAGG TCTTTAACT TCGGTTTTTT CCGATAAATT CTTGCCGCAT	5307
TAAAATTCCA GATTCCCGCT TTCGCGGGGA TGACGGCGGG GGGATTGTTG CTTTTTCGGA	5367
TAAAATCCCG TGTTTTTTCA TCTGCTAGGT AAAATCGCCC CAAAGCGTCT GCATCGCGGC	5427
GATGGCGGCG AGTGGGGCGG TTTCTGTGCG TAAAATCCGT TTTCCGAGTG TAACCGCCTG	5487
AAAGCCGGCT TCAAATGCCT GTTGTCTTC CTGTTCTGTC CAGCCGCCTT CGGGCCCCGAC	5547
CATAAAGACG ATTGCGCCGG ACGGGTGGCG GATGTCGCCG AGTTTGCAGG CGCGGTTGAT	5607
GCTCATAATC AGCTTGGTGT TTTCAGACGG CATTTTGTGCG AGTGCTTCAC GGTAGCCGAT	5667
GATGGGCAGT ACGGGGGGAA CGGTGTTCTT GCCGCTTTGT TCGCACGCGG AGATGACGAT	5727
TTCCTGCCAG CGTGCGAGGC GTTTGGCGGC GCGTTCTCCG TCGAGGCGGA CGATGCAGCG	5787
TCGCTGATG ACGGGCTGTA TGGCGGTTAC GCCGAGTTTCG ACGCTTTTTT GCAGGGTGAA	5847
ATCCATGCGA TC	5859

(2) INFORMATION FOR SEQ ID NO:8:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 279 amino acids
- (B) TYPE: amino acid
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:8:

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Met Gln Asn His Val Ile Ser Leu Ala Ser Ala Ala Glu Arg Arg Ala
 1              5              10              15
His Ile Ala Ala Thr Phe Gly Ser Arg Gly Ile Pro Phe Gln Phe Phe
      20              25              30
Asp Ala Leu Met Pro Ser Glu Arg Leu Glu Arg Ala Met Ala Glu Leu
      35              40              45
Val Pro Gly Leu Ser Ala His Pro Tyr Leu Ser Gly Val Glu Lys Ala
      50              55              60
Cys Phe Met Ser His Ala Val Leu Trp Glu Gln Ala Leu Asp Glu Gly
      65              70              75              80
Val Pro Tyr Ile Ala Val Phe Glu Asp Asp Val Leu Leu Gly Glu Gly
      85              90              95
Ala Glu Gln Phe Leu Ala Glu Asp Thr Trp Leu Gln Glu Arg Phe Asp
      100              105              110
Pro Asp Ser Ala Phe Val Val Arg Leu Glu Thr Met Phe Met His Val
      115              120              125
Leu Thr Ser Pro Ser Gly Val Ala Asp Tyr Gly Gly Arg Ala Phe Pro
      130              135              140
Leu Leu Glu Ser Glu His Cys Gly Thr Ala Gly Tyr Ile Ile Ser Arg
      145              150              155              160
Lys Ala Met Arg Phe Phe Leu Asp Arg Phe Ala Val Leu Pro Pro Glu
      165              170              175
Arg Leu His Pro Val Asp Leu Met Met Phe Gly Asn Pro Asp Asp Arg
      180              185              190
Glu Gly Met Pro Val Cys Gln Leu Asn Pro Ala Leu Cys Ala Gln Glu
      195              200              205
Leu His Tyr Ala Lys Phe His Asp Gln Asn Ser Ala Leu Gly Ser Leu
      210              215              220
Ile Glu His Asp Arg Arg Leu Asn Arg Lys Gln Gln Trp Arg Asp Ser
      225              230              235              240
Pro Ala Asn Thr Phe Lys His Arg Leu Ile Arg Ala Leu Thr Lys Ile
      245              250              255
Gly Arg Glu Arg Glu Lys Arg Arg Gln Arg Arg Glu Gln Leu Ile Gly
      260              265              270
Lys Ile Ile Val Pro Phe Gln
      275

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(2) INFORMATION FOR SEQ ID NO:9:

- (i) SEQUENCE CHARACTERISTICS:
 - (A) LENGTH: 21 base pairs
 - (B) TYPE: nucleic acid
 - (C) STRANDEDNESS: single
 - (D) TOPOLOGY: unknown

- (ii) MOLECULE TYPE: cDNA
- (iii) HYPOTHETICAL: NO
- (iv) ANTI-SENSE: NO
- (vi) ORIGINAL SOURCE:
 - (A) ORGANISM: PCR primer
- (xi) SEQUENCE DESCRIPTION: SEQ ID NO:9:

GCCGAGAAAA CTATTGGTGG A

21

(2) INFORMATION FOR SEQ ID NO:10:

- (i) SEQUENCE CHARACTERISTICS:
 - (A) LENGTH: 22 base pairs
 - (B) TYPE: nucleic acid
 - (C) STRANDEDNESS: single
 - (D) TOPOLOGY: unknown
- (ii) MOLECULE TYPE: cDNA
- (iii) HYPOTHETICAL: NO
- (iv) ANTI-SENSE: NO
- (vi) ORIGINAL SOURCE:
 - (A) ORGANISM: PCR primer

- (xi) SEQUENCE DESCRIPTION: SEQ ID NO:10:

AAAACATGCA GGAATTGACG AT

22

(2) INFORMATION FOR SEQ ID NO:11:

- (i) SEQUENCE CHARACTERISTICS:
 - (A) LENGTH: 348 amino acids
 - (B) TYPE: amino acid
 - (D) TOPOLOGY: linear

- (ii) MOLECULE TYPE: protein

- (xi) SEQUENCE DESCRIPTION: SEQ ID NO:11:

Leu Gln Pro Leu Val Ser Val Leu Ile Cys Ala Tyr Asn Val Glu Lys
1 5 10 15
Tyr Phe Ala Gln Ser Leu Ala Ala Val Val Asn Gln Thr Trp Arg Asn
20 25 30
Leu Asp Ile Leu Ile Val Asp Asp Gly Ser Thr Asp Gly Thr Leu Ala
35 40 45
Ile Ala Lys Asp Phe Gln Lys Arg Asp Ser Arg Ile Lys Ile Leu Ala
50 55 60
Gln Ala Gln Asn Ser Gly Leu Ile Pro Ser Leu Asn Ile Gly Leu Asp
65 70 75 80

Glu Leu Ala Lys Ser Gly Gly Gly Gly Gly Glu Tyr Ile Ala Arg Thr
 85 90 95
 Asp Ala Asp Asp Ile Ala Ser Pro Gly Trp Ile Glu Lys Ile Val Gly
 100 105 110
 Glu Met Glu Lys Asp Arg Ser Ile Ile Ala Met Gly Ala Trp Leu Glu
 115 120 125
 Val Leu Ser Glu Glu Lys Asp Gly Asn Arg Leu Ala Arg His His Lys
 130 135 140
 His Gly Lys Ile Trp Lys Lys Pro Thr Arg His Glu Asp Ile Ala Ala
 145 150 155 160
 Phe Phe Pro Phe Gly Asn Pro Ile His Asn Asn Thr Met Ile Met Arg
 165 170 175
 Arg Ser Val Ile Asp Gly Gly Leu Arg Tyr Asp Thr Glu Arg Asp Trp
 180 185 190
 Ala Glu Asp Tyr Gln Phe Trp Tyr Asp Val Ser Lys Leu Gly Arg Leu
 195 200 205
 Ala Tyr Tyr Pro Glu Ala Leu Val Lys Tyr Arg Leu His Ala Asn Gln
 210 215 220
 Val Ser Ser Lys His Ser Val Arg Gln His Glu Ile Ala Gln Gly Ile
 225 230 235 240
 Gln Lys Thr Ala Arg Asn Asp Phe Leu Gln Ser Met Gly Phe Lys Thr
 245 250 255
 Arg Phe Asp Ser Leu Glu Tyr Arg Gln Thr Lys Ala Ala Ala Tyr Glu
 260 265 270
 Leu Pro Glu Lys Asp Leu Pro Glu Glu Asp Phe Glu Arg Ala Arg Arg
 275 280 285
 Phe Leu Tyr Gln Cys Phe Lys Arg Thr Asp Thr Pro Pro Ser Gly Ala
 290 295 300
 Trp Leu Asp Phe Ala Ala Asp Gly Arg Met Arg Arg Leu Phe Thr Leu
 305 310 315 320
 Arg Gln Tyr Phe Gly Ile Leu Tyr Arg Leu Ile Lys Asn Arg Arg Gln
 325 330 335
 Ala Arg Ser Asp Ser Ala Gly Lys Glu Gln Glu Ile
 340 345

(2) INFORMATION FOR SEQ ID NO:12:

- (i) SEQUENCE CHARACTERISTICS:
 - (A) LENGTH: 337 amino acids
 - (B) TYPE: amino acid
 - (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:12:

Leu Gln Pro Leu Val Ser Val Leu Ile Cys Ala Tyr Asn Ala Glu Lys
 1 5 10 15
 Tyr Phe Ala Gln Ser Leu Ala Ala Val Val Gly Gln Thr Trp Arg Asn
 20 25 30
 Leu Asp Ile Leu Ile Val Asp Asp Gly Ser Thr Asp Gly Thr Pro Ala
 35 40 45
 Ile Ala Arg His Phe Gln Glu Gln Asp Gly Arg Ile Arg Ile Ile Ser
 50 55 60
 Asn Pro Arg Asn Leu Gly Phe Ile Ala Ser Leu Asn Ile Gly Leu Asp
 65 70 75 80
 Glu Leu Ala Lys Ser Gly Gly Gly Glu Tyr Ile Ala Arg Thr Asp Ala
 85 90 95
 Asp Asp Ile Ala Ser Pro Gly Trp Ile Glu Lys Ile Val Gly Glu Met
 100 105 110
 Glu Lys Asp Arg Ser Ile Ile Ala Met Gly Ala Trp Leu Glu Val Leu
 115 120 125
 Ser Glu Glu Asn Asn Lys Ser Val Leu Ala Ala Ile Ala Arg Asn Gly
 130 135 140
 Ala Ile Trp Asp Lys Pro Thr Arg His Glu Asp Ile Val Ala Val Phe
 145 150 155 160
 Pro Phe Gly Asn Pro Ile His Asn Asn Thr Met Ile Met Arg Arg Ser
 165 170 175
 Val Ile Asp Gly Gly Leu Arg Phe Asp Pro Ala Tyr Ile His Ala Glu
 180 185 190
 Asp Tyr Lys Phe Trp Tyr Glu Ala Gly Lys Leu Gly Arg Leu Ala Tyr
 195 200 205
 Tyr Pro Glu Ala Leu Val Lys Tyr Arg Phe His Gln Asp Gln Thr Ser
 210 215 220
 Ser Lys Tyr Asn Leu Gln Gln Arg Arg Thr Ala Trp Lys Ile Lys Glu
 225 230 235 240
 Glu Ile Arg Ala Gly Tyr Trp Lys Ala Ala Gly Ile Ala Val Gly Ala
 245 250 255
 Asp Cys Leu Asn Tyr Gly Leu Leu Lys Ser Thr Ala Tyr Ala Leu Tyr
 260 265 270
 Glu Lys Ala Leu Ser Gly Gln Asp Ile Gly Cys Leu Arg Leu Phe Leu
 275 280 285
 Tyr Glu Tyr Phe Leu Ser Leu Glu Lys Tyr Ser Leu Thr Asp Leu Leu
 290 295 300
 Asp Phe Leu Thr Asp Arg Val Met Arg Lys Leu Phe Ala Ala Pro Gln
 305 310 315 320
 Tyr Arg Lys Ile Leu Lys Lys Met Leu Arg Pro Trp Lys Tyr Arg Ser
 325 330 335

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